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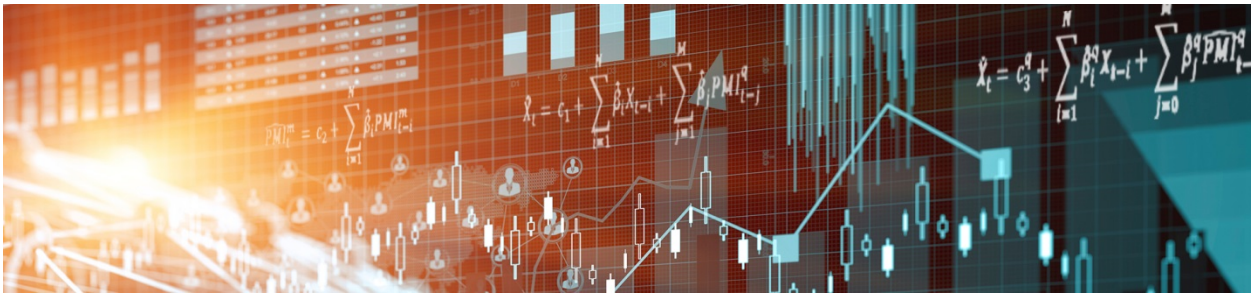
Changing Fortunes: Long-Termism—G-Zero, Artificial Intelligence and Debt



by Stephen S. Poloz

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Changing Fortunes: Long-Termism—G-Zero, Artificial Intelligence and Debt

by

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Abstract

This paper discusses three long-term forces that are acting on the global economy and their implications for companies and policy-makers:

1. the transition in geopolitics away from a global order based on international co-operation, or "deglobalization";
2. the spread of new technology, particularly artificial intelligence, through the "fourth industrial revolution"; and
3. the steady buildup of debt—public and private—in most countries.

Deglobalization leads to reduced investment and the deconstruction of global value chains, which will reduce global potential economic growth and living standards. The fourth industrial revolution will foster a period of stronger productivity growth and low inflation, accompanied by significant labour market disruptions. High and growing debt levels raise a range of risks associated with financial vulnerabilities. As well, the coincident rise in populism with doubts about the value of central bank independence risks an alignment of incentives between governments and highly indebted households, favouring a return to inflationary policies in the future. The paper concludes with a list of inferences and long-term policy implications. It was developed from a talk first delivered at the Spruce Meadows Changing Fortunes Round Table in Calgary, Alberta, in September 2019.

Topics: Financial stability; International Topics; Monetary policy; Trade integration; Uncertainty and monetary policy

JEL Codes: E, E6, E63, F, F02, F1, F15, F5, F53, F6, H, O, O11, O33

Résumé

La présente étude traite de trois forces de long terme qui agissent sur l'économie mondiale, ainsi que de leurs conséquences pour les entreprises et les décideurs :

1. La transition géopolitique qui nous éloigne d'un ordre mondial basé sur la coopération internationale, ou « démondialisation ».
2. La diffusion de nouvelles technologies, en particulier l'intelligence artificielle, par la voie de la « quatrième révolution industrielle ».
3. L'accumulation continue de la dette, tant publique que privée, dans la plupart des pays.

La démondialisation entraîne une baisse des investissements et la déconstruction des chaînes de valeur mondiales, ce qui réduira la croissance économique potentielle et le niveau de vie à l'échelle de la planète. La quatrième révolution industrielle donnera lieu à une période de croissance accrue de la productivité et de faible inflation, qui sera aussi marquée par d'importantes perturbations du marché du travail. Un niveau d'endettement élevé et croissant engendre divers types de risques liés aux vulnérabilités financières. De plus, la montée simultanée du populisme et des doutes quant à la valeur de l'indépendance des banques centrales pourrait faire converger les incitations des autorités publiques et celles des ménages

fortement endettés de manière à favoriser un retour à des politiques inflationnistes. L'étude se termine par une liste de conclusions et de conséquences à long terme pour les politiques. Elle s'inspire d'un discours prononcé à la Table ronde de Spruce Meadows *Changing Fortunes*, à Calgary (Alberta), en septembre 2019.

Sujets : Stabilité financière; Questions internationales; Politique monétaire; Intégration des échanges; Incertitude et politique monétaire

Codes JEL : E, E6, E63, F, F02, F1, F15, F5, F53, F6, H, O, O11, O33

Introduction

Ron Southern was quite a guy. He always dreamed big, and he always got it done. And despite all his success, he always had time for you. It was nothing for Ron to call you up at short notice, invite you to lunch and spend a couple of hours with you, just so you could have a conversation.

Actually, mostly what he wanted to do was to listen. Ron was a collector of ideas. He turned that vocation into his biggest idea—to create a global dialogue around the key issues of the day, to bring a diverse group of people together, get them talking and hope that the dialogue would build after everyone went home. We are all very lucky that the tradition lives on with the Southern family.

To be asked to lead the conversation today is truly an honour, and a very weighty responsibility. I hope I can measure up, to do what Ron would have wanted and get you thinking differently about the key issues of the day.

I will organize my talk around three big, long-term forces that will affect our businesses and our economy far into the future. This topic reflects my concern that we tend to be overly occupied with short-term issues and can miss the big, slow-moving forces that are coming at us. In short, one of my goals today is to promote long-termism.

The first big force I will talk about is the transition we are seeing in global geopolitics. It can be described in various ways, but I will describe it as a shift from co-operative coexistence toward geopolitical competition. It is popular to associate this shift with one or two political figures, but the underlying forces run deeper.

The second big force acting that I want to discuss is the spread of digitalization throughout the economy and the emergence of artificial intelligence, or AI. This has been called the fourth industrial revolution, and I will draw on our experience with the first three industrial revolutions—the steam engine, electrification and the computer chip—to help us understand what may come next.

These two long-term forces may seem distant from monetary policy. However, they are very much the domain of the central banker, as we cannot do our jobs without understanding political and technological trends. But the third big long-term force acting that I want to discuss today hits very close to home for a central banker: the relentless buildup of debt in virtually every corner of the globe. Households, firms and governments alike are all building up debt. I will put this buildup into historical perspective and consider alternative ways in which it could affect us in future.

Many other long-term forces are acting on the global economy that we could consider today, like climate change, for example. However, I am not trying to be exhaustive in identifying long-term issues for us to discuss. I want today's discussion to be about interesting alternative futures and have chosen three forces to explore. By exercising the muscles of understanding alternative projections, we can build the ability to adapt to whatever comes our way.

The baseline outlook for the future

To anchor our conversation, it is useful to begin with a baseline long-term projection for the global economy. If things settled down and no new disturbances were hitting the economy, we would converge on what economists call a steady state, in which certain relationships are likely to hold.

Economic growth comes from population growth (technically, labour force growth) and productivity growth. Productivity growth is driven by investment in new capacity and advances in technology. Population growth is relatively simple to predict, but productivity growth is very complicated, as it depends on the progress and deployment of technology, which is never smooth. As economists, we generally just extrapolate recent trend productivity growth into the future; these days, a typical trendline for productivity growth is around 1 percent per year for advanced economies, higher for emerging economies. Accordingly, an economy with 1 percent population growth and 1 percent productivity growth would exhibit about 2 percent trend economic growth, and the economy would fluctuate around that trend.

In that steady state, the real, or inflation-adjusted, short-term rate of interest will tend to be driven by that economic growth rate. The intuition behind this association is that stronger economic growth is generally associated with more borrowing, so interest rates rise to encourage more savings to bring the system back to balance. We call this steady-state interest rate the natural rate, or the neutral rate or, more lately, "r-star." If trend productivity growth were to pick up, for example, thereby boosting economic growth, we would expect the natural rate of interest to rise as well. Long-term real interest rates would be higher than the short-term rate, depending on how far out you go. In other words, the yield curve would be upward sloping because in the steady state there would be a positive term premium.

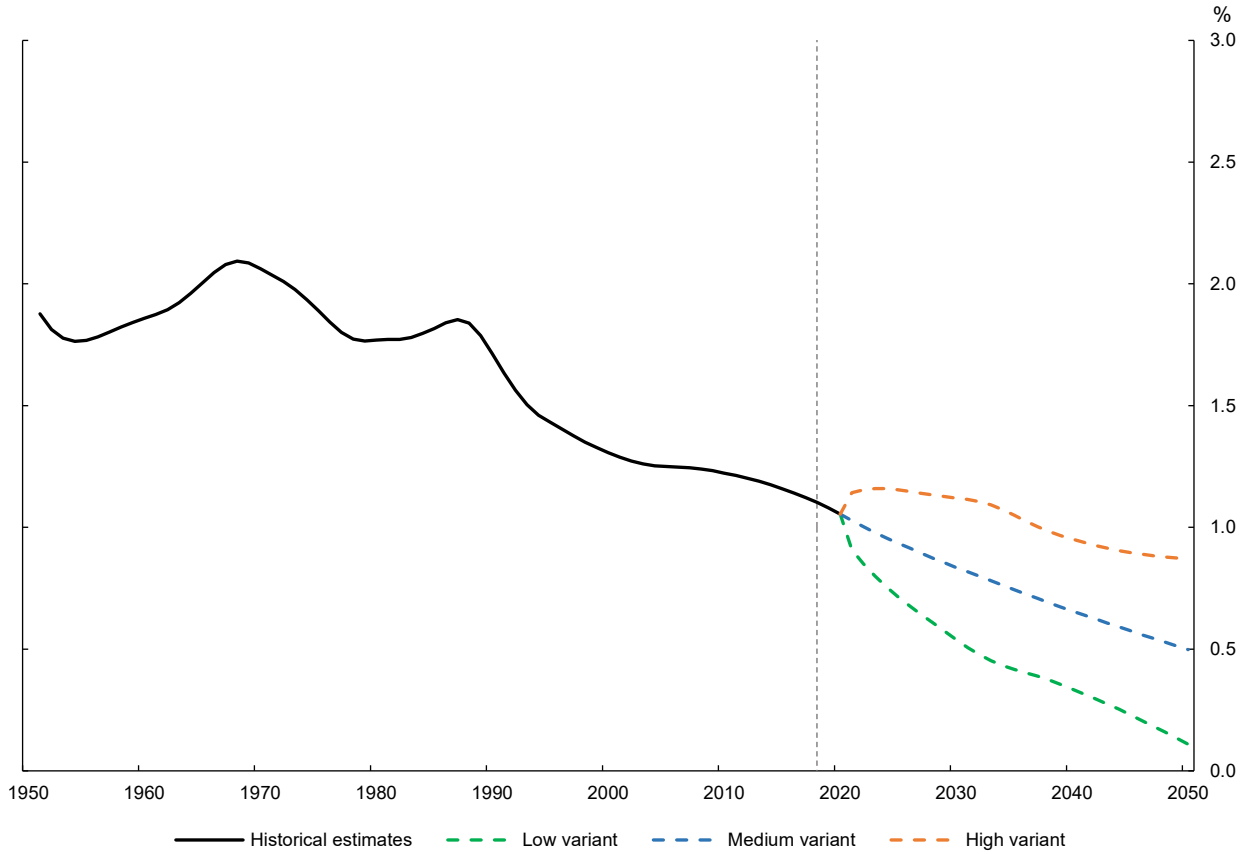
Now, we need to add inflation to this picture. If the economy were growing in inflation-adjusted terms at, say, 2 percent and inflation was 2 percent, then in revenue terms the economy would be growing at 4 percent. And if the steady-state real rate of interest were around 2 percent, the interest rate we all pay, what we call the nominal rate of interest, would be around 4 percent.

In summary, in a steady state, all of these concepts are linked together. In the short term, they all fluctuate for multiple reasons, and this long-term relationship between them may not be all that evident. But they are anchored together, like a group of drunks walking down the Red Mile during the Calgary Stampede, tied together by a series of six-foot ropes.

The main anchor to this steady state is population growth, and it has been slowing. Global population growth peaked in the mid-1960s at about 2 percent per year and has been steadily declining since then. Today it is running at about 1 percent per year and is projected to slow further to about 0.5 percent per year by 2050 (**Chart 1**). This is mostly a return to normal after the post-war baby boom, which boosted population growth (and lowered the average age) for the following 70 to 80 years.

Chart 1: World population growth, 1950–2050

Annual data



Source: United Nations

Last observation: 2019

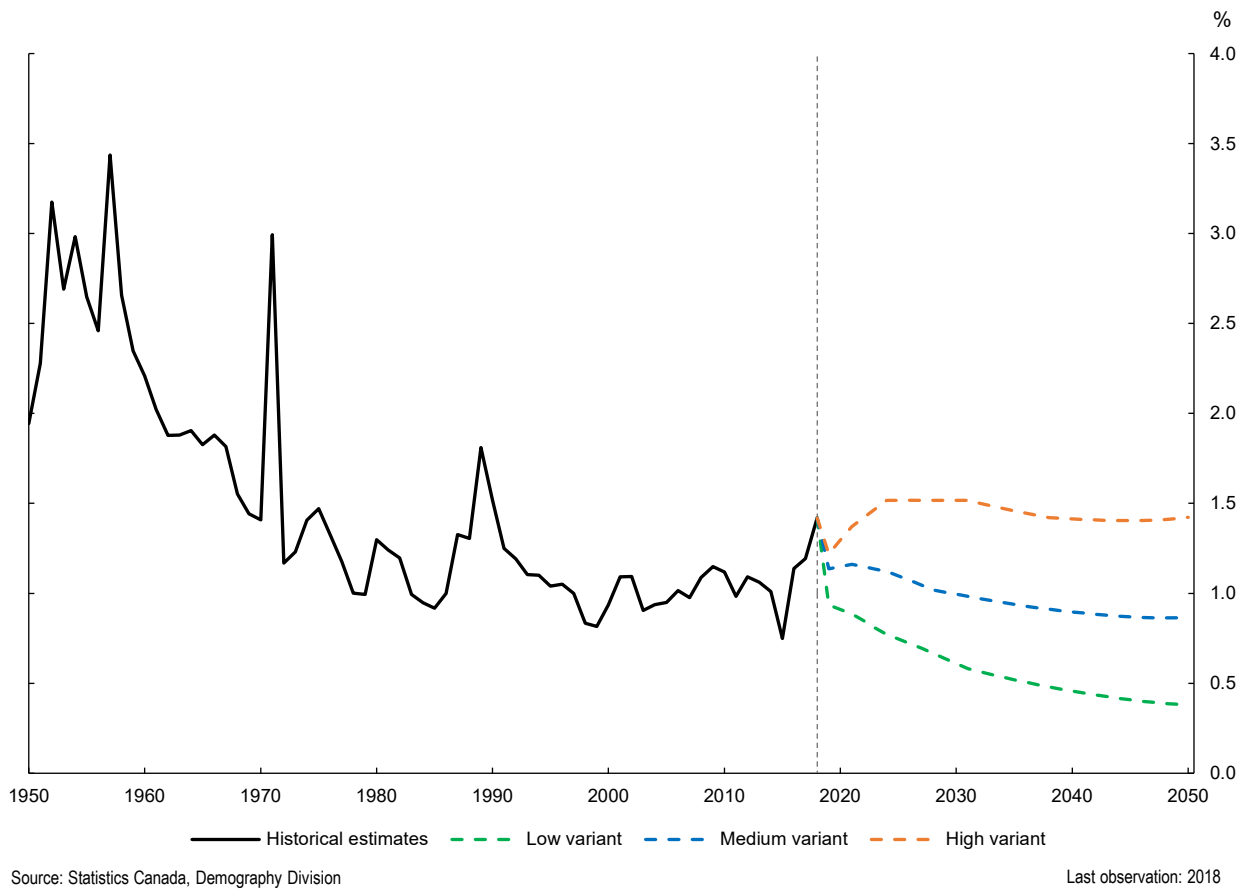
Notes: All series are from the United Nations' *World Population Prospects*, specifically the 2019 revision (UNDESA 2019). The projections correspond to the low-, medium- and high-growth variants described therein.

When I mention these population growth rates, people are often surprised at how low they are. But low growth rates can achieve a lot over a long period. In the 1950s, there were fewer than 3 billion people on the planet. Today we are approaching 8 billion, and most projections are for about 10 billion by 2050.

Here in Canada, the story is similar, as shown in **Chart 2**. But it is more interesting, because it is affected by waves of immigration. Our peak population growth rate was in the 1950s, at nearly 3 percent per year. There has been a pretty steady moderation since then, punctuated by immigration waves, around 1970, 1990 and in the last few years. Population growth formed a bottom around 2000 at about 0.75 percent per year. Since then, immigration has brought us closer to 1 percent. In the last couple of years, we have had a significant uptick in immigration, as you know. There is a range of scenarios for the future, with Canadian population growth likely to range between 0.5 percent (same as the global projection) and 1.5 percent per year, depending on our immigration policies.

Chart 2: Canadian population growth, 1950–2050

Annual data



Source: Statistics Canada, Demography Division

Last observation: 2018

Notes: The historical series corresponds to the Q3-to-Q3 changes in the quarterly population estimates reported in Statistics Canada Table no. 17-10-0009-01. The projections correspond to low-, medium- and high-growth assumptions.

Despite these nuances, the basic insight is the same for Canada as for the world: economic growth has slowed, globally and in Canada, mainly because population growth has slowed. There is more downside risk coming, even if we maintain solid immigration flows. That is because our population is aging steadily, so workforce growth may be even slower than population growth. This, in turn, is most of the explanation for why global real rates of interest have been on a declining trend.

Of course, productivity growth matters too. Scientific breakthroughs can lead to higher productivity growth and therefore higher economic growth and, in turn, higher steady-state interest rates. It is also possible to use policies to break the link between population growth and labour force growth. For example, policies to boost labour force participation by women or older workers, or policies to address the rising incidence of mental illness, could help offset demographic declines. There are also a range of policy changes that could help raise trend productivity growth. Indeed, many of the big growth spurts in history have come from structural reforms. Land reforms in China, for example, were instrumental in freeing workers from the countryside, allowing them to move to the cities and become manufacturing workers. Such structural reform opportunities exist in all economies, both advanced and developing, but executing such reforms depends mainly on politics—which brings us to our first major force acting.

Force acting #1: the global geopolitical transition

The global order we have enjoyed through most of our lives was the product of two world wars and has served us well for some 75 years, so far. Under this global order, economies ran mostly on the basis of free markets. International trade was considered essential to specialization of work and therefore productivity and economic growth. Governments focused on infrastructure, education and health care and used policies to smooth economic fluctuations and redistribute incomes to protect the disadvantaged. Central banks were primarily responsible for providing low and predictable inflation to foster good economic decision making and help smooth economic fluctuations. It was not a perfect order, but it worked.

The global financial crisis and the subsequent Great Recession raised serious questions about this model. All the ingredients of another Great Depression were present in 2008, so avoiding it was a major policy victory. Nevertheless, there is a broad perception that Wall Street was bailed out, and taxpayers paid for it while also suffering from the effects of the Great Recession. Meanwhile, recovery from the global financial crisis was slow, and what has emerged is a relatively slow growth rate, driven by slow productivity growth and a growing sense that a lot of people are not sharing in economic progress.

As Harberger (1998) once argued, economic growth is often thought of as like yeast, appearing gradually everywhere, in which case everyone gets some of the benefit. Certainly, this is the supposition in most economic models. In fact, economic growth is more like mushrooms, as it pops up in pockets and those positioned to reap the rewards do so while many others are left out. Growth is often based on new technology. Howitt (2015) has extended this argument to posit that economic growth is contentious, or political, by its very nature. Everyone wants some, but only a few actually benefit. Some people actually lose out in the process, so it takes politics to redistribute the benefits of growth in the real world.

Considerable research supports the view that technological progress has been the main driver of economic restructuring in our times. By economic restructuring, I mean the need for firms to adapt to new technology, which means laying off existing workers and creating jobs for new-age workers. Nevertheless, the effects of globalization look very similar—firms must adapt to forces of international competition and produce some of their components in a low-wage country, laying off workers in the domestic economy in the process.

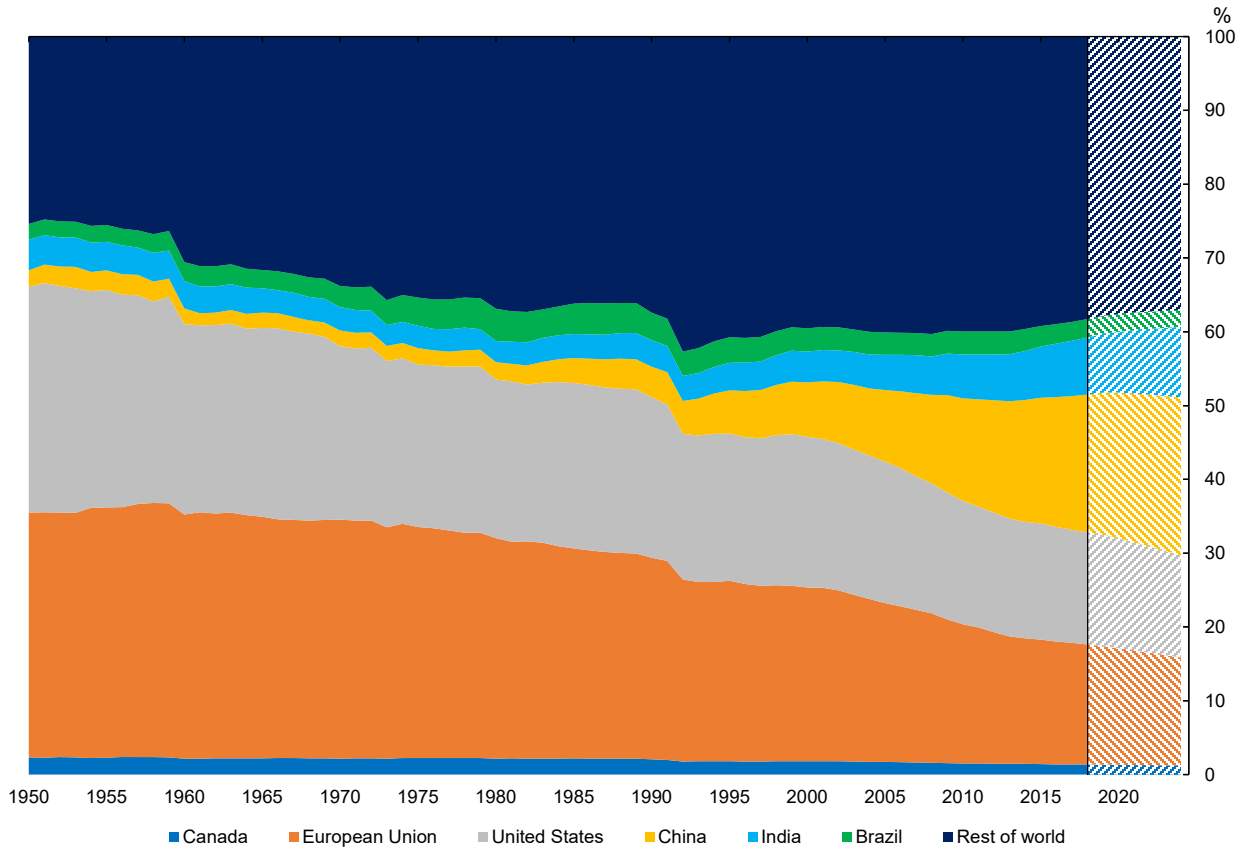
Globalization has allowed companies to maximize their specialization, productivity and profitability. Companies assemble products from parts that are made wherever the specialists are, and connect them through international trade, an architecture we call global supply chains. Society at large wins in the form of lower prices and increased purchasing power, but there are those who benefit a lot and those who benefit much less or not at all, and some who actually lose their jobs and find it very hard to recover. Possibly because it is easier to understand, globalization has been the target of more angst among workers than new technology. In any case, workers' level of anxiety is elevated.

Meanwhile, the international context has not stood still. Since the 1950s, the US and European economies have declined in importance from around 30 percent of the world economy each to about 15 percent each. China is now larger than that and still growing relatively quickly. India is not far behind (**Chart 3**). This sense of diminishing economic clout in advanced economies is palpable.

For all these reasons, and others, many people are frustrated and unhappy. The rise of social media has provided a way to amplify this frustration. Countries with weak redistributive policies were first to show rising populism, but there appears to be a shift in that direction globally. Given all these developments, a shift toward a domestic focus, toward a more competitive international posture, is at least explainable, whether logical or not.

Chart 3: Global shares of gross domestic product

Annual data



Sources: International Monetary Fund, Maddison Project Database (Bolt, Inklaar, de Jong and van Zanden 2018) and Bank of Canada calculations Last observation: 2018

Notes: For 1980 on, all series correspond to GDP at purchasing power parity (PPP) as a share of the world total, as reported in the October 2019 edition of the IMF's *World Economic Outlook*. Before 1980, countries' individual GDP series were computed on a break-adjusted basis using the 2018 version of the Maddison Project Database (Bolt et al. 2018), then summed and used to compute shares of global output.

A more populist or competitive global order is less likely to be guided by the principles of free markets, free international trade and shared technological progress. Structural reforms in the domestic economy are generally unpopular—they often share the characteristic of short-term pain for long-term gain—and take considerable political will to enact. The global arena may be equally problematic. Until recently, one might have predicted that increased cross-country interdependence due to globalization would foster more political give and take, not less, if only because any reversal of globalization would be self-defeating. But what has emerged instead is a willingness to use economic interdependence as leverage, threatening to disrupt the system to extract concessions from others in the belief that the situation is zero-sum, or at least that the others have more to lose than the disruptor.

Ian Bremmer of Eurasia Group calls his version of this future a “G-Zero world.” The idea is that we have over the years developed co-operative international forums, such as the G7 and G20, to make enlightened decisions about the world. But if the underlying spirit of co-operation continues to erode, we can end up in a G-Zero world, where there is diminished global leadership and nations focus more on their own narrow interests. Meanwhile, political consensus is becoming harder to achieve as social media amplify voices, create echo chambers and polarize politics. This can make good policies exceedingly difficult to develop and execute, especially policies like growth-enhancing structural reforms that can have negative consequences for some individuals in the short run.

Let’s consider how this shift in our geopolitical environment might affect our baseline scenario. To begin with, the uncertainty this shift poses plays directly into business investment decisions. If a business depends on international trading rules to grow, then the new uncertainty around those rules is likely to deter new investment. We are seeing this in many countries today. We saw it first in Canada, Mexico and the United States because the North American Free Trade Agreement was the first target of the Trump administration, starting in early 2017. We are seeing it in the United Kingdom in the face of the uncertainty around Brexit, where investment is substantially lower than before the Brexit referendum. Companies look at growth opportunities with a hurdle rate of return in mind. If the risk-adjusted return on a project falls below the hurdle rate because risks have risen, the investment is shelved until the situation improves.

This reduction in investment can be made worse if companies fail to account for the decline in the neutral interest rate I discussed earlier. Companies that are still working with hurdle rates from 10 years ago will find fewer investment opportunities that exceed those rates. The implication is that companies need to adjust hurdle rates downward to reflect the new reality and then seek ways to manage elevated risk besides. Indeed, when the neutral rate of interest is very low, long-term investments where the returns are far into the future may be much more compelling than in normal times. Lower investment spending means slower economic growth now, and it means that the economic potential of our economies will grow more slowly over the long term as well. In other words, it reduces both demand and supply in the global economy.

Reduced investment due to uncertainty is only one channel through which “deglobalization” affects the economy. Trade restrictions will directly erode the specialization in production that delivered big productivity gains in the past. In other words, economic growth will slow further in a trade-restricted world. And the transition to a slower growth rate will entail firms dismantling global supply chains and rebuilding them, destroying existing capital stock and building new capital stock. In other words, we could go through an extended period of disruptive adjustment and slower economic growth before settling into a new, lower, growth trend.

There are still policy options in a G-Zero world, of course. Monetary policy is ill-equipped to offset a trade-disruption shock to the economy because the impact is permanent in nature. At best, monetary policy is able to buffer the shock in the short term and help the economy to adjust through time. However, countries can still create new free-trade zones with like-minded countries, growing trade to counter the negative effects of trade restrictions in other countries. Canada already has more unrestricted access to other markets than most other countries. Once a new global trade order has emerged, it presumably will generate less investor uncertainty than the present one, leading to increased business investment spending, but it is simply not possible to predict the ultimate outcome.

Furthermore, Canada can do a lot to increase its own trend economic growth rate even if other countries engage in a trade war. This includes promoting basic research and the commercialization of innovation. Research and development (R&D) enjoys economies of scale—more technological progress is made by pooling innovations, a characteristic that efforts like organizing and backing sectoral clusters are intended to achieve. Even during the Great Depression of the 1930s, some important innovations had long-term effects on our economy. Companies like Dupont and General Electric demonstrated that maintaining investment in R&D is critical to long-term business performance.

Canada could also boost growth by dismantling interprovincial trade barriers. Ironically, it was after the United States abrogated its 1854 Reciprocity Treaty with the Canadian colonies in 1866 that the concept of a Canadian Confederation was born, the idea being to promote trade within Canada and become less reliant on trade with the United States.

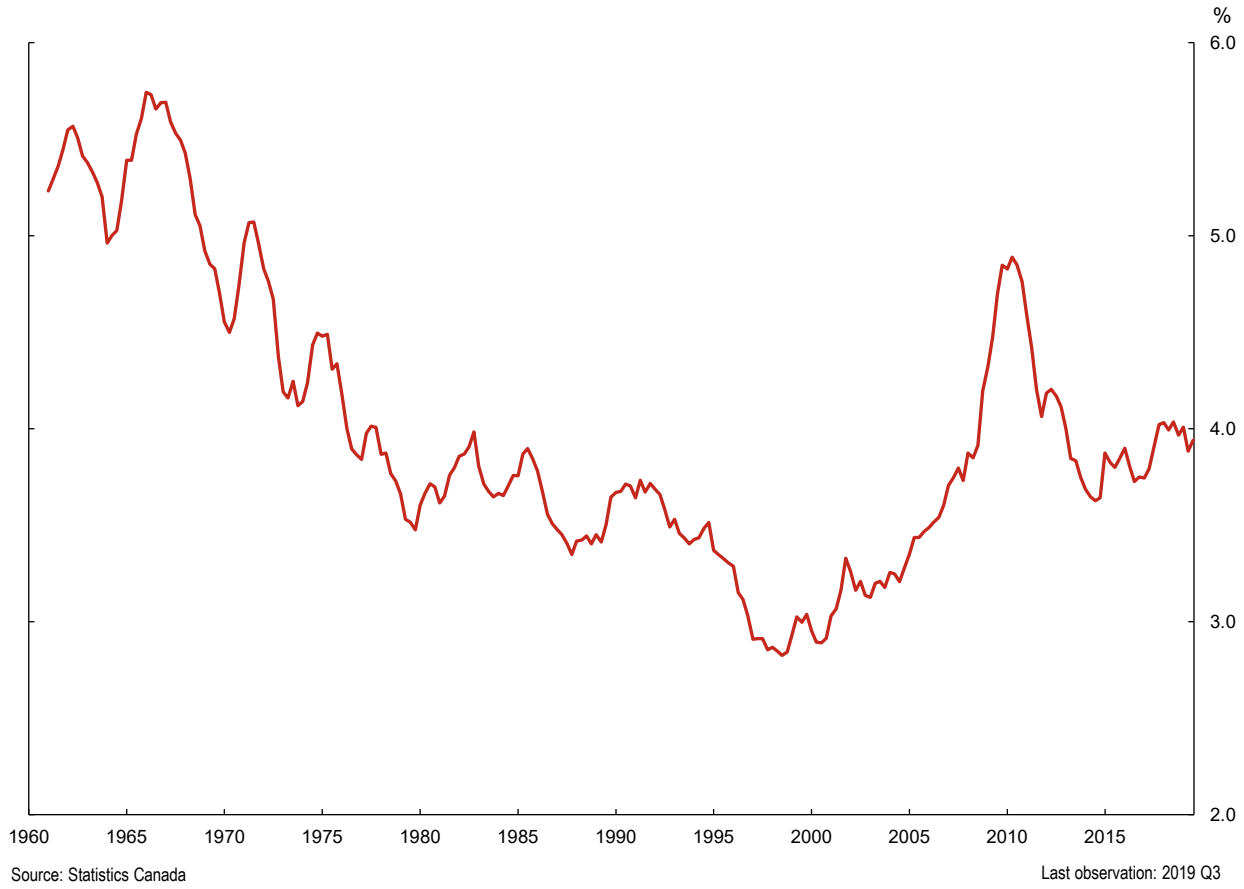
Productivity growth also depends heavily on growth-enhancing infrastructure. Workers who spend less time in traffic jams are more productive; firms that have access to excellent roads, ports, airports, pipelines, reliable power and telecommunications have higher productivity than those that do not. As a case study, consider that it took building the Canadian Pacific Railway (CPR) to create what we call Canada today. It cost approximately $140 million to build the CPR in the early 1880s, which was equal to about 25 percent of Canada's gross national product (GNP) in 1885. A cost of $140 million in the early 1880s would be equivalent to around $4 billion in 2019.

Today, $4 billion doesn't seem to go as far as it used to, but Canadian governments have spent a lot on infrastructure in the past decade, averaging over 4 percent of GDP, or around $80 billion annually. The most recent uptrend in infrastructure spending began in 2008–10, in response to the Great Recession. As **Chart 4** illustrates, this followed a period of steadily declining infrastructure spending during the preceding 30 years, during which a significant shortfall in infrastructure developed. The current infrastructure program at the federal level amounts to some $180 billion spread over around 10 years, a factor that will certainly contribute to sustaining Canada's long-term growth potential.

There are of course many more possible futures in a G-Zero competitive world. My intention is to get you thinking and talking. But it should be clear from the above that technological progress holds the most hope for raising our trend economic growth rate. This is ironic, given that new technology probably contributes more to people's anxiety than globalization does. This brings me to our second major force acting.

Chart 4: Investment by Canadian governments (all levels) as a share of gross domestic product

Quarterly data



Notes: Government investment and GDP data are both from Statistics Canada table no. 36-10-0104-01.

Force acting #2: the fourth industrial revolution

We are living in the fourth industrial revolution, a term coined by Klaus Schwab (2016) of the World Economic Forum. The effects on our economy are likely to be profound, judging from the first three industrial revolutions.

A brief sketch of the economic history of humankind is instructive. For a very long time, humans existed as wandering hunter-gatherers, spending all day seeking their next meal. The first big innovation in this technology was agriculture—the discovery that by staying in one place people could plant their own food and raise their own animals. The process of economic specialization began right there. Some people would grow food, others would raise animals, and they could trade with one another. Eventually they became so good at it all that there was extra production, which gave humans the ability to create culture, government, a military and so on. Today, everybody executes their specialty and uses money to trade for what else they need.

Globalization of exchange between people was the next step in this development process. The trade in goods and services was no longer just with neighbours, it was across borders, across oceans. Notice that international trade is not between countries, but between people located in different countries. Specialization in economic activity is what delivers the high productivity, the societal surplus, and trade (whether domestic exchange or trans-border trade) makes us all better off than if we did it all ourselves. Globalization as we refer to it today differs from 200 years ago only in intensity and in the fragmentation of products and services into geographically distributed supply chains.

Technological progress has been a persistent feature of this history. This steady progress has been punctuated by significant leaps in productivity, driven by the adoption of general-purpose technologies. These leaps are big enough to be labelled "industrial revolutions."

The first industrial revolution, generally dated from the late 1700s until the late 1800s, was about the invention and widespread application of the steam engine, which replaced human or animal energy with something much more powerful. That revolution freed many people from hard labour, which is another way of saying they lost their jobs. Companies experienced a major shakeout: those who adopted the new technology could offer their wares at a huge discount relative to those who did not. A lot of this competition came from companies in the new economy in North America. The North American economy was barely getting started at the time of the first industrial revolution, so adopting new technologies was easier than in Europe, where established companies needed to abandon their old technology and invest in the new, a highly disruptive process that took much longer.

Economic theory makes this adjustment process sound easy. The new technology can produce the same goods—cloth, say—far more cheaply than the old technology. Cloth prices fall, making it far more affordable. People who buy cloth now have more money left over to buy other things. That extra demand for other goods creates new jobs across the economy, so people who lose their jobs in the cloth industry because of the new technology can eventually find new jobs in other sectors.

The reality is that the full macroeconomic adjustment process to a new technology takes a long time. Workers displaced by new technology lose their purchasing power and the economy slows. Falling prices increase the burden of outstanding debt, for both individuals and firms, slowing the economy further. It takes a long time for the new growth in other sectors and the brand-new jobs related to the new technology to enable everyone to find their new place in the economy. Fiscal and monetary policies can facilitate this adjustment and reduce the short-term downside risk to the economy.

Today, we refer to the period of intense adjustment that followed the first industrial revolution, from 1873 to 1896, as the Victorian Depression, a very difficult period in economic history. It was often called the Great Depression, until the 1930s came along. For reasons of space I won't go into all the factors that contributed to the Victorian Depression. Rather, I just want to argue that an important contributor was the adjustment process spawned by the first industrial revolution. The proximate catalyst to the depression itself was a financial collapse, following an extended period of booming stock prices, centred in Vienna. An important contributing factor was the absence of any true fiscal or monetary policy to help cushion or stabilize the economy. Indeed, the world economy was operating on the gold standard, which meant that the supply of money could not expand unless more gold was discovered and produced. Here in Canada, the Victorian Depression helped motivate infrastructure spending by the fledgling federal government. It built the CPR, thinking that the spending and expanding confederation to the West would promote economic growth.

The second industrial revolution was based on the combination of electrification and mass production. The period of generalized adoption ran from the late 1800s to the mid-1900s. Firms became vertically integrated, and production activities of individuals within those firms became highly specialized, organized along an assembly line. This made previously very expensive items like automobiles much more affordable. It also made makers of buggy whips and horseshoes redundant. Again, the economy's capital stock needed to be replaced with new technology. Early movers were able to offer their wares at substantially lower prices, forcing their competitors to restructure or exit. Many workers lost their jobs, although new jobs were also being created.

Once again, the world needed to absorb a sudden increase in supply capability, and the prices of a range of products declined. Accompanying this was a stock market frenzy that was only partly based on valid perceptions of improved earnings potential for companies, the remainder being pure speculation. When the stock bubble burst, the global economy fell into the Great Depression of the 1930s. Just like the Victorian Depression, economies were stagnant or contracting and experienced prolonged deflation. The interaction of deflation with existing debt again exacerbated the episode because it eroded firms' ability to service their debt. Although the United States had a central bank by then—and the Bank of Canada was created in 1935—the macroeconomic situation was poorly understood. J. M. Keynes argued for fiscal stimulus; unfortunately, when it came in substance it was in the form of the Second World War.

The third industrial revolution was based on the computer chip—electronics and information technology combined to allow the automation of production and the coordination of logistics at a distance. This revolution dates from the mid-1970s. Workers were displaced directly by the new technology, but we saw the creation of new products and services that no one had dreamed of before, and those activities created new jobs that no one had dreamed of before either. At the same time, it enabled companies to enhance the logistics of supply chains, which permitted even more specialization on fragmented production processes and then allowed the scope of the production chain to go global. Firms responded by becoming less vertically integrated and more horizontally integrated, where the bits and pieces were produced in other countries and joined together by international trade. In effect, technological advances and the opening up of new economies like China worked together to make globalization possible.

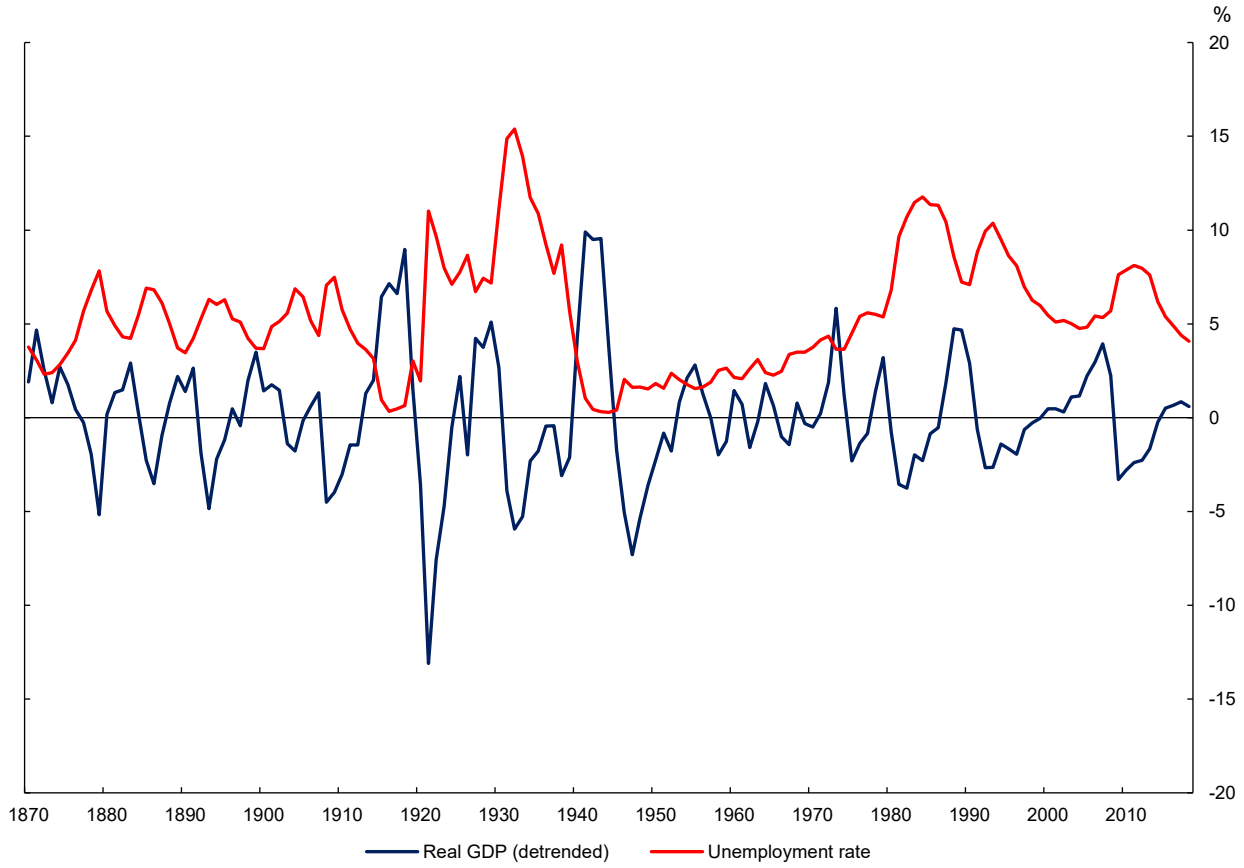
Once again, the world needed to adjust to a significant increase in supply capability, and the adjustment took a long time. A good deal of the new production capacity was located in Asia, as the globalization of supply chains was focused there. China's accession to the World Trade Organization in 2001 was a key driver in this. Prices of many goods fell significantly, from televisions to desktop computers to clothing and shoes. The competitive strains spawned a series of exchange rate devaluations throughout Asia. Again, there was a stock market bubble, based partly on the real implications of new technologies, but also on pure speculation. Again, the interaction between falling prices of goods and pre-existing indebtedness added to stresses for companies and governments. These were the ingredients that led to contagion across Latin America and Russia.

Unlike the first two industrial revolutions, the third was not associated with a global depression. It was associated with a stock market boom and collapse (the dot.com bubble and subsequent tech wreck). But the adjustment costs were more focused on countries such as Thailand, South Korea, Argentina and Russia. Some might include Japan on this list, which exhibited some depression-like symptoms for much of the 1990s.

I would attribute this better macroeconomic outcome to smarter policy-making, both monetary and fiscal, relative to the first and second industrial revolutions. Indeed, one could take hope from the fact that the 1930s Great Depression was less prolonged than the Victorian and the global adjustments to the third industrial revolution were faster still. This progression suggests that monetary and fiscal policies are becoming increasingly effective through the passage of time. At the same time, the pace of change within industrial revolutions has increased each time, which may make adjustments even harder for people.

Chart 5: UK GDP growth and unemployment, 1870–2018

Annual data



Sources: Bank of England, UK Office for National Statistics and Bank of Canada calculations

Last observation: 2018

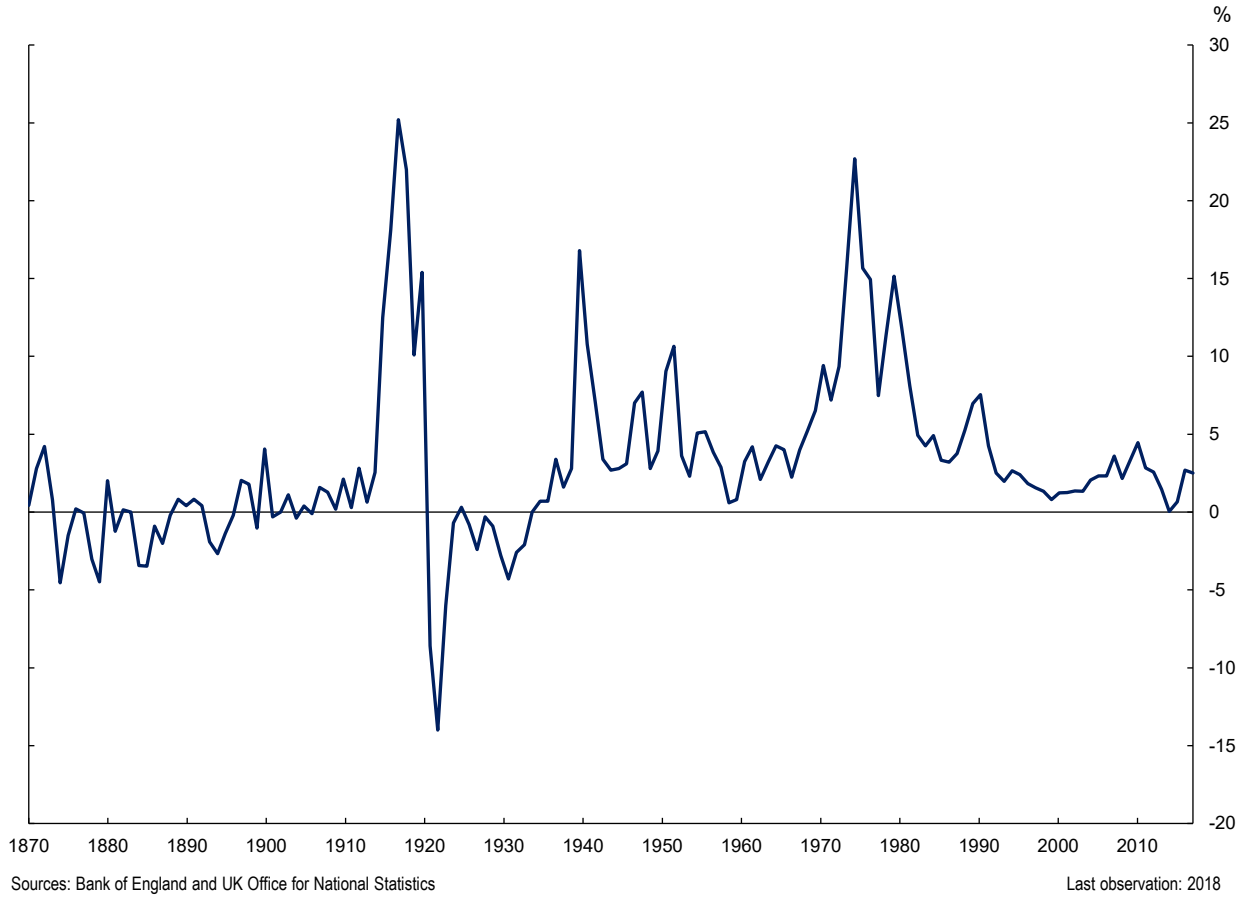
Notes: Up to 2016, the GDP series corresponds to the year-over-year change in real GDP, as reported in the series “Real UK GDP at market prices, geographically consistent estimate based on post-1922 borders” in the Bank of England’s dataset “A millennium of macroeconomic data for the UK.” Thereafter, the series was extended using “ABMI” from the UK Office for National Statistics. The resulting real GDP series was then detrended using a Hodrick-Prescott filter with a smoothing parameter of 100. The unemployment rate series corresponds to the “unemployment rate as a percentage of total UK workforce” in the Bank of England's dataset "A millennium of macroeconomic data for the UK,” extended using the series “MGRZ” and “MGSC” from the UK Office for National Statistics.

Indeed, because of the subdued inflation pressures that accompanied the third industrial revolution, monetary policy remained easy for an extended period. This is exactly what one would expect when an economy’s supply capability is expanding faster than demand. But this prolonged period of easy money in turn fuelled financial speculation and helped to create a housing bubble in the United States as well as

excessive leverage in many areas of the global financial system. The bursting of that bubble led to the global financial crisis and the Great Recession, which easily could have been a global depression but again was averted through aggressive fiscal and monetary policies. For policy-makers, the main lesson learned was that monetary policy can still make mistakes while doing the right thing. Today, financial stability considerations are becoming increasingly prominent in monetary policy decision making, and many countries have developed macroprudential policies to help manage financial stability risk.

Chart 6: UK inflation, 1870–2018

Annual data



Sources: Bank of England and UK Office for National Statistics

Last observation: 2018

Notes: Up to 2016, the series corresponds to year-over-year changes in the series "Consumer Price Index (CPI) – Preferred measure" in the Bank of England's dataset "A millennium of macroeconomic data for the UK." Thereafter, the series was extended using the series "D7G7" from the UK Office for National Statistics.

It is beyond the scope of this paper to document every aspect of this long-term narrative here. However, a good summary can be taken from the history of economic growth and inflation in the United Kingdom, as shown in charts 5 and 6. One can see clearly the persistent weak growth and deflation associated with the Victorian Depression and the Great Depression, and the persistent disinflation in the third industrial revolution. Of course, this is not meant to be a complete accounting of the history of inflation, but to suggest that these characteristics are likely to emerge during any period of major technological progress.

Today, we find ourselves early in the fourth industrial revolution, the digitalization of the global economy. At its heart is machine learning and AI, which have the potential to increase efficiency in all areas of economic activity. The same fear that confronted individuals during the first three industrial revolutions is widely apparent. Some have estimated that up to 50 percent of Canadian jobs may be at risk. These include a wide range of repetitive human tasks, such as driving, operating agricultural machinery, financial advising and providing customer service in settings such as call centres or retail.

Economic history has been most aptly described by Joseph Schumpeter (1942) as a process of creative destruction. Every innovation creates economic growth while destroying something based on old technology. But focusing only on the job losses misses half the picture. Consider the mechanization of agriculture as one example. When Canada was formed in 1867, about 50 percent of our population was engaged in agriculture. Today it is less than 2 percent, but agricultural output per person has increased massively. Meanwhile, the digital economy today is more than 5 percent of our total economy, and employment in this sector is growing four times faster than the total economy. None of these jobs existed before the third industrial revolution. We can extrapolate and conclude that, eventually, there will be meaningful jobs for all of those who are displaced by the fourth.

The pace of this adjustment process will be influenced by policies. This can extend beyond the basics of fiscal and monetary policies, which buffer the system and guide it to a new steady state. The analogy of growth being more like mushrooms than yeast implies that the corporate sector could become increasingly concentrated. This was certainly a feature of the second industrial revolution. This trend can reduce the forces of competition and can push increasing shares of national income into the top echelons of earners. This may lead to pressures to sharpen redistributive mechanisms in fiscal frameworks and to toughen anti-trust policies.

It is understandable that waves of adjustment make both workers and companies anxious. Workers wonder how they will adapt to a new workplace, while companies find it difficult to find the workers with the skills they need to grow. Education systems try to facilitate this adaptation, but investment in human capital takes time. To me, this suggests that companies that invest disproportionately in their employees will create a comparative advantage for themselves.

At the macroeconomic level, we can extrapolate experience from the first three industrial revolutions and conclude that, eventually, there will be meaningful jobs for all of those who are displaced by the fourth industrial revolution. After all, the vast majority of Canadians are employed today, despite three previous industrial revolutions, each of which destroyed many jobs. Besides, we know that many individuals were displaced by the first three industrial revolutions, and that the economy took some time to adjust to each one.

Consider the common example of driverless vehicles. The economics of replacing a truck with a driverless vehicle will depend on the cost of the new truck, how long the replacement will take to pay for itself given that the driver loses his job, and so on. Driverless vehicles will need to be monitored, managed and maintained; in other words, automation will be supervised. This will not be costless to the truck owner and will involve many new jobs. It could take a long time—perhaps decades—to replace the trucks on the road today.

Even so, it is worth considering what the displaced truck drivers of the future will do. The answer will depend on what the creators, manufacturers, programmers, monitors and maintainers of driverless trucks do with their new incomes. For one thing, those people will buy houses, and this will create jobs

for people who build them, renovate them, maintain furnaces, make furniture and so on. This is only a glimpse of the general equilibrium effect of an increase in income that comes from a new technology. The point is, while some never-imagined jobs are created, many traditional jobs are also created in the process, and the upskilling required for a truck driver to migrate to a construction trade, for example, does not appear insurmountable.

This analysis is encouraging, but it still leaves open the possibility that the other features of the first three industrial revolutions—two depressions, various financial crises, the Great Recession—will also figure prominently in the fourth. We can expect that falling prices for goods and services, possibly generalized deflation and the dislocation of workers could again create depression-like symptoms while adjustment takes place. No doubt, these stresses will cross over into the political issues discussed earlier.

Nevertheless, our experience with the previous three industrial revolutions suggests that policy-makers are learning as they go along and are well-equipped to deal with the fourth Industrial revolution. Conceptually, this would entail allowing the supply-led economic expansion to run, as happened during the third industrial revolution. Central banks would use inflation targets to anchor monetary policy while policy-makers would ensure that imbalances in the financial system are contained using macroprudential policies. While this may sound simple, in practice it is made very difficult by the policy-maker's inability to guess how rapidly economic potential is likely to grow and for how long.

From a company point of view, the current situation is doubly complicated. The fourth industrial revolution is unfolding while we go through a disruptive transition in geopolitics. Indeed, the two are interacting. Moreover, after working so hard to combat the Great Recession, most policy-makers have modest capacity to respond to adverse events. Interest rates are already very low, and debt levels are very high. This brings me to my third major force acting—a global accumulation of debt.

Force acting #3: rising debt burdens

Debt is crucial to the functioning of the economy. It is only through borrowing that households, firms and governments can operate over time. It is obviously not preferable for households to save for 25 years and then buy a house just as they become empty nesters, rather than using a mortgage to buy a home in which they can raise their family. Similarly, for a firm looking to expand to meet excess demand, having to wait to accumulate retained earnings before expanding could mean missing the growth opportunity. And for governments, borrowing to build infrastructure creates an asset that delivers returns to society today, while facilitating private sector growth and generating tax revenues for years to come. It makes little sense to force governments never to borrow for such a purpose.

That said, there have been many historical episodes when households, firms and governments have borrowed excessively, making the economy vulnerable to outside disturbances. For households, the biggest driver of debt is the purchase of housing. Canadian households tend to buy as much house as they can afford. And by "afford" we mean that they can manage to service the debt and gradually pay down the principal with their income. What that means is that an increase in interest rates or the loss of a job by one member of the household can stress the situation, causing people to default on their mortgage. This can pose problems for financial institutions. It can weaken the housing market, cause prices to fall and magnify the original shock to the economy. A similar argument may be made for firms.

In the lead up to the global financial crisis in 2007–08, for example, debt related to the US housing market skyrocketed. Underwriting standards had been compromised repeatedly, and the global economy paid a steep price when the day of reckoning came. Estimates are that at least $10 trillion in global output was lost during the subsequent 10-year period—more than 10 percent of global GDP.

Today, the world is carrying historic levels of debt. The distribution among households, firms and governments varies among countries, but aggregate debt has more than doubled in the past decade. Global debt now totals around US$250 trillion—US$100 trillion more than before the financial crisis and about three times current global GDP.

Here in Canada, much of the focus has been on household debt. At nearly 180 percent of disposable income, we are at an all-time high, although not quite as high as other countries such as Sweden or Australia. Importantly, this is largely the product of the prolonged period of extraordinarily low interest rates. The reason for low interest rates was to help the economy withstand major shocks from outside. Boosting the demand for housing, and therefore household borrowing, was the intention of those policies. But of course, back in 2008, no one really believed that 10 years later the rate environment would still be very low. The negative side-effects of the policy have grown steadily over time.

This accumulation of household debt is Canada's most important financial vulnerability. Based on the long-term economic outlook sketched earlier, this remains manageable. Debt service as a share of income is still at a reasonable level by historical standards. Of course, the vulnerability will be with us for a very long time—arguably for a generation, or at least until mom and dad leave behind their real estate and savings to help millennials pay off their debts.

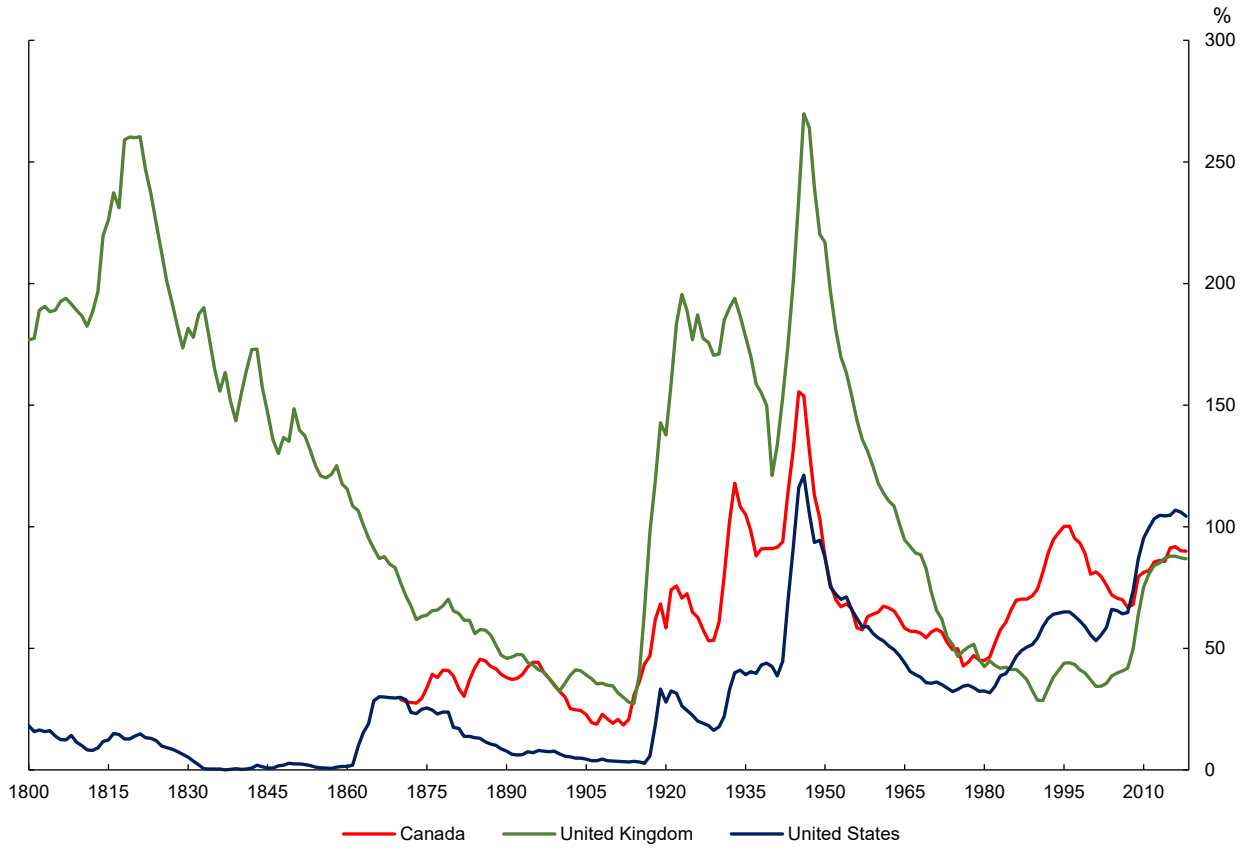
In other countries, such as the United States and Japan, the stock of government debt is most worrisome. Canada has avoided this at the federal level, precisely because through much of the post-crisis period we used low interest rates rather than expansionary fiscal policy to address a weak economy. However, adding provincial government debt into the mix brings Canada's government debt level as a share of the economy closer to other major economies (**Chart 7**).

One can argue that government debt levels of more than 200 percent of GDP have been managed in the past (the United Kingdom in the early 1800s and 1940s, Japan today). But the question is what sort of risks do today's debt levels present for the future? There is more than one way to manage a debt burden, some more insidious than others. This analysis is particularly relevant when considering the other long-term forces that are acting on the economy, as discussed earlier.

Today, population growth is slowing, and economic growth with it. Therefore, unlike the generation that came after the huge run-up in debt associated with the Second World War, we cannot count on rapid growth in the population or the economy to help work off this debt burden. Indeed, as our populations age, fiscal burdens will grow further through health care spending. Certainly, a significant leap in productivity, and therefore economic growth, due to the fourth industrial revolution offers hope of a speedy pay-down of today's debt, private or public. But based on past industrial revolutions that could be a long time coming.

Chart 7: Public sector debt in Canada, the United Kingdom and the United States, 1800–2018

Debt as percent of GDP, annual data



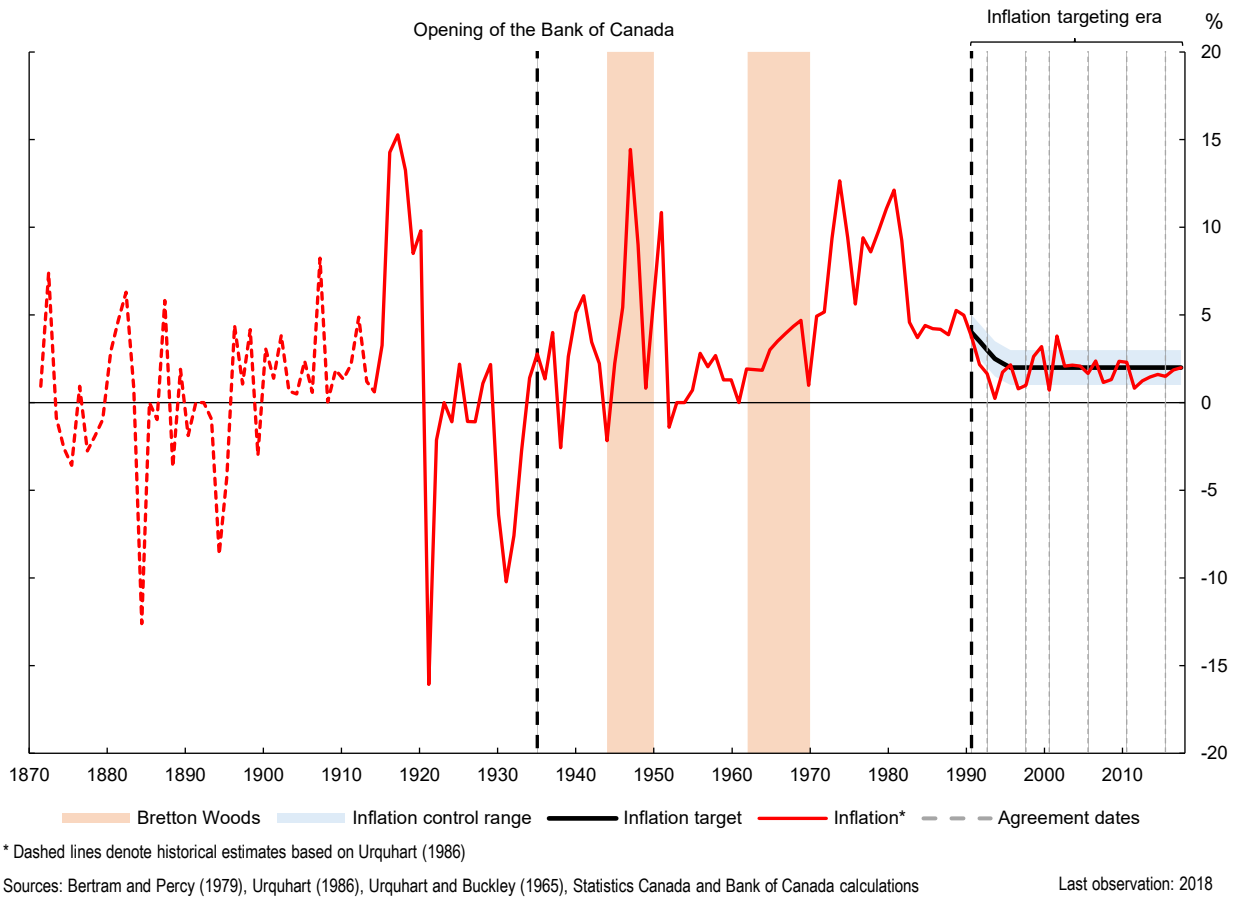
Sources: International Monetary Fund; Jordà, Schularick and Taylor (2017)

Last observation: 2018

Notes: For 1980 on, the Canadian and UK series correspond to general government gross debt as a percent of GDP, as reported in the October 2019 edition of the IMF's World Economic Outlook Database (WEO). Before 1980, the Canadian and UK series correspond to government gross debt as a percent of GDP, as reported in the IMF's Historical Public Debt Database. For the US series, the IMF's Historical Public Debt Database was used up to 1979 and the WEO for the years 2001 and beyond. For the interceding years, data limitations necessitate use of the public debt-to-GDP series in the Jordà-Schularick-Taylor macroeconomic database (Jordà, Schularick and Taylor 2017). Note also that US data points for the years 1835 and 1836 are missing from the IMF's Historical Public Debt Database and have been linearly interpolated.

Chart 8: Inflation in Canada, 1870–2018

Annual data



* Dashed lines denote historical estimates based on Urquhart (1986)

Sources: Bertram and Percy (1979), Urquhart (1986), Urquhart and Buckley (1965), Statistics Canada and Bank of Canada calculations

Last observation: 2018

Notes: From 1915 on, the inflation series corresponds to the December-to-December percent changes in total CPI, as reported in Statistics Canada Table no. 18-10-0004-01. Prior to 1915, the inflation series (as marked by the dashed line) corresponds to percent changes in an annual cost of living index produced following the methodology in Urquhart (1986). Entry and exit dates from the Bretton Woods system are based on Bordo, Gomes and Schembri (2010).

And then there is politics. A swerve toward populism brings with it a higher risk of future inflation. Consider that questions are being raised in many countries about the value of central bank independence and the primacy of inflation targets. It is not hard to imagine alternative futures where low and stable inflation is no longer a given.

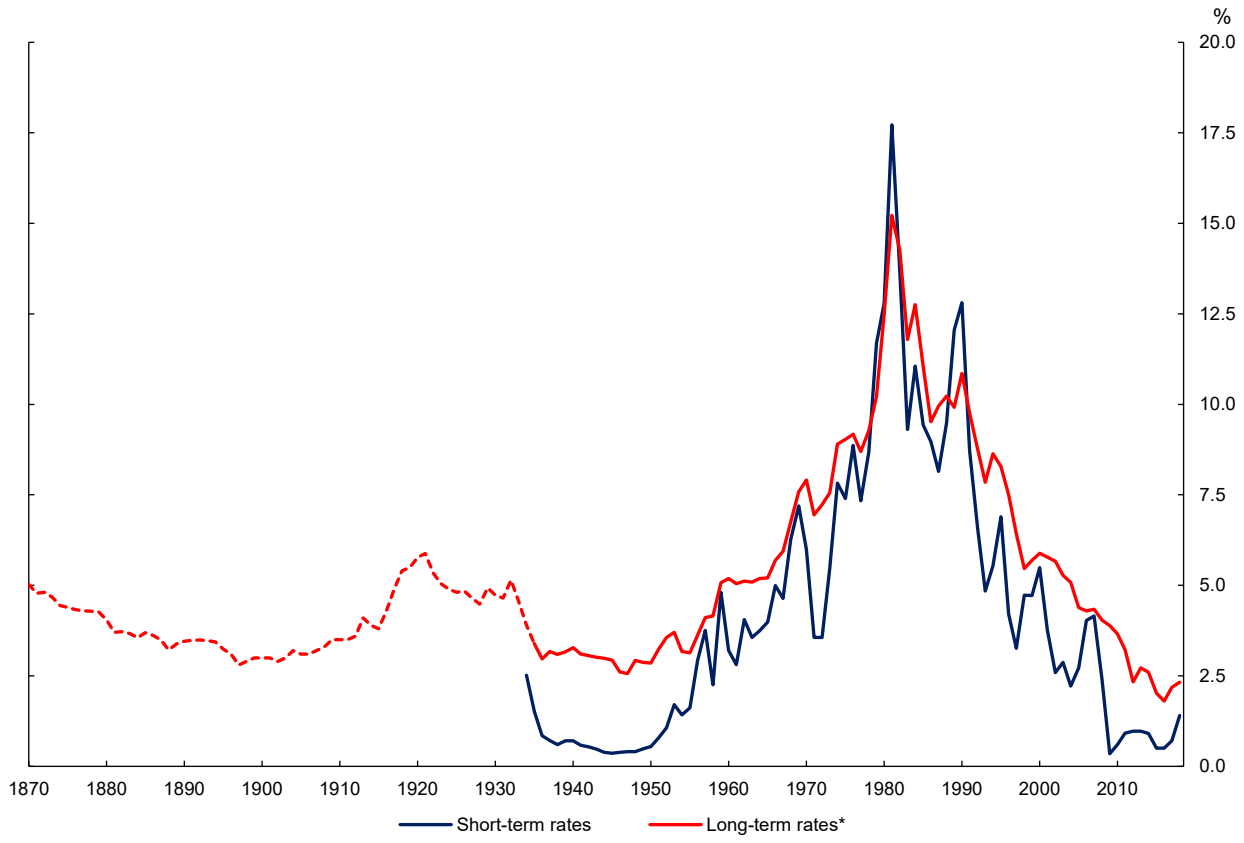
The history of the relationship between debt and inflation is pretty clear: large buildups in debt, especially government debt, have historically been followed by outbreaks of inflation (around the two world wars, the 1970s), as shown in **Chart 8**. Consider, in particular, the Great Inflation of the 1970s. The 1950s and 1960s saw very low and stable inflation. This regime was broken by fiscal stresses in the United States related to the Vietnam War. Excessive monetary expansion led to a surge in inflation pressures, and these were exported around the world through the Bretton Woods fixed exchange rate system. That system broke, but not soon enough to prevent a global inflation surge. The stresses were compounded by big hikes in oil prices, which reduced the supply capability of all the major economies.

Economies slowed even as inflation rose, making it more challenging for policy-makers to keep inflation pressures at bay.

It took until the early 1990s to rectify this combination, at great economic expense. However, consider the fact that the running costs of high and variable inflation were also very large, including labour market inefficiency. In other words, lower and more stable inflation has also given us lower and more stable employment outcomes. Nevertheless, it needs to be recognized that the Great Inflation of the 1970s was a double gift to indebted households. First, real estate prices rose significantly. In Canada, using Toronto as an example, the average single detached home rose in price by about 150 percent between 1970 and 1980. Second, a mortgage taken out in 1970 effectively fell to less than half its original value by 1980, measured in 1970 dollars. In contrast, stocks and bonds delivered very poor returns. Sophisticated investors paid a very high price; less-wealthy households whose primary assets were in real estate made out very well.

Chart 9: Nominal interest rates in Canada, 1870–2018

Annual data



* Dashed lines denote historical estimates based on Jordà, Schularick and Taylor (2017)

Sources: Jordà, Schularick and Taylor (2017) and Statistics Canada

Last observation: 2018

Notes: The short-term series corresponds to the average yield at auction on three-month treasury bills, as reported in Statistics Canada Table no. 10-10-0122-01. For 1936 on, the long-term series corresponds to the average yield on marketable Government of Canada bonds with maturities over 10 years, as reported in the same table. Before 1936, the long-term series (as marked by the dashed line) is from the Jordà-Schularick-Taylor macrohistory database (Jordà, Schularick and Taylor 2017).

A similar dynamic applied to government debt. With cumulative inflation of more than 100 percent over the 1970s, the value of outstanding government debt was cut by more than half. During the 1980s inflation averaged more than 6 percent a year, further eroding the value of outstanding debt. Since the 1990s, inflation has averaged very close to 2 percent per year. This still represents an erosion in value, but through most of that time, bondholders were compensated with interest rates well above the inflation rate, as you can see in **Chart 9**. In this sense, the inflation of the 1970s and 1980s represented a transfer of wealth from investors to governments.

It is fair to say that governments did not set out in the late 1960s to create faster inflation or to confiscate investor wealth to reduce fiscal debt burdens. However, we should at least consider the possibility of a confluence of incentives between indebted households and indebted governments to tolerate another global inflationary episode. Financial markets appear to be attaching very low weight to this risk today. There was a time not so long ago when it was believed that the bond market vigilantes would ensure that no government would ever again dabble with inflation risk. The immediate response would be a backup in bond yields because of the higher inflation risk, and through that mechanism all taxpayers would pay for that increased risk immediately. There has been little such reaction to recent salvos against the independence of central banks.

In Canada, we are fortunate to have a formal agreement between the central bank and the government to maintain a low and stable rate of inflation. **Chart 8** shows just how special the inflation-targeting period has been historically. This agreement is reviewed thoroughly every five years. Nevertheless, a shrinking minority of people remember our past inflationary experience. The state of geopolitics suggests that long-term investors should take the risk of higher global inflation more seriously. That risk would bring with it the risk of higher nominal interest rates, despite our earlier arguments about lower real interest rates (**Chart 9**).

Concluding remarks

My objective was to help bring a degree of long-termism back to the corporate table by laying out some of the long-term forces acting on our economy and speculating on how they might affect our baseline projection. Out of this analysis I have drawn 10 tentative inferences that I offer you now. Some of these are framed from a corporate perspective, but they all have macroeconomic implications.

1. Politics is becoming an increasingly important driver of the economic and business outlook. Political risk analysis may see a resurgence—a chief political analyst to work with your chief economist, perhaps.
2. Population growth will remain slow, so future economic growth will rely almost completely on infrastructure building and technological innovation. Because there are economies of scale in R&D and in infrastructure, there is a clear role for governments in both spaces.
3. We are likely to remain in a lower rate of return world. Companies and shareholders will need to adjust their rate of return expectations.
4. Deglobalization poses a significant risk to the global and Canadian outlooks. This will lower the level of potential output and its long-term growth rate. Furthermore, future trade patterns could look very different; for example, the huge trade relationships in the future could be between countries such as India, China and Brazil. Capturing some of the trade flows between those big players is likely to be a good growth strategy.

5. Demographics mean that competition for human talent will be of growing importance. Companies can create their own competitive advantage by taking on more of the burden of employee education, such as advanced forms of apprenticeships or mentoring.
6. There will not always be a first-mover advantage with new technology. In some sectors, being a follower could be a better strategy, as not all new technologies will become general-purpose.
7. Firms of every stripe will be expected—either by investors or by regulation—to report on and limit their contributions to climate change. Firms that can help other firms adapt will be in a growth business, just as firms that help companies move onto the cloud are doing well today.
8. The accumulated stock of debt makes the world economy vulnerable, and population aging is going to make the situation more challenging. Further, the forces acting point to disproportionate income gains at the top of the income distribution. Fiscal frameworks could come under stress and may need to be altered radically.
9. The risk of an outbreak of inflation remains low but seems higher than it has been over the past 30 years. The confluence of an elevated stock of debt and the shift toward populism in politics raises this risk, while the effects of the fourth industrial revolution should help mitigate it.
10. The responses to debt stresses could vary significantly between countries. If some countries choose to risk higher inflation while others do not, there may be a growing risk of outsized exchange rate volatility.

These inferences are highly debatable, and others may have come to you already. But I think the real value is in considering the scope of possible alternative futures and how we would adapt to them.

In case I have left you with a feeling of despair, let me end on a hopeful note. Yes, there are some profound long-term forces at work in the global economy. Left unchecked, they could produce some dire consequences. But these trends are happening very gradually, and there are many things we can do to mitigate them, or even take advantage of them, provided we have invested in understanding them and are working through the options available.

As a central bank charged with conducting monetary policy, the Bank of Canada must be cognizant of these interacting long-term forces, because they can have profound implications for the macroeconomy. I am confident that history has taught policy-makers how to deal with these alternative futures.

Of course, the whole notion of “alternative futures” is an acknowledgement of the uncertainty we face. These days, there is much discussion of uncertainty, whether political or economic. Indeed, some might argue that it is not helpful to try to forecast the future in these conditions. There is no doubt that uncertainty has risen since 10 or 20 years ago. However, taking a longer-term historical view helps to put the current era into sharper relief. Society has experienced generation-defining bouts of economic and political uncertainty several times in the past. Yet we are all still here.

The long-term forces acting on us will bring about “changing fortunes,” as Ron Southern so aptly named his series of round tables. Fortunately, Canadians have a proven ability to ensure that at least some of those changing fortunes work in our favour.

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